Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Technology Transitions Policy Task Force	)	
Request For Comments on Potential Trials	)	GN Docket No. 13-5

COMMENTS OF HARRIS CORPORATION

Harris Corporation (Harris) respectfully submits these comments in response to the Federal Communications Commission's (Commission) Technology Transitions Policy Task Force (Task Force) proposal of a set of potential trials relating to transition from copper to fiber, from wireline to wireless, and from time-division multiplexing (TDM) to IP.[1] Harris appreciates the opportunity to make clear the risks to public safety that could be increased if TDM-IP and wireless trials are not done in a manner that does not impact the Federal Aviation Administration's (FAA) air traffic control systems that are dependent upon TDM wireline services.

[1] *See* Technology Transitions Policy Task Force Seeks Comment On Potential Trials, GN Docket No. 13-5, Public Notice, (rel. May 10, 2013) (Task Force Trial PN).

I. SUMMARY.

As noted in an earlier filing,[2] Harris Corporation is the Prime Systems Integrator for the FAA Telecommunications Infrastructure (FTI) Program. FTI is the primary means through which the FAA acquires the telecommunications services required for National Airspace System (NAS). The NAS, consisting of thousands of people, procedures, facilities, and pieces of equipment, enables safe and efficient air travel in the United States and over large portions of the world's oceans. While efforts are being made through the FAA's "NextGen" Programs to upgrade the NAS to communications interfaces based upon Internet Protocol (IP) standards, over 92% of FTI services continue to be TDM-based. Moreover, while the FAA is in the process of modernizing it communications interfaces, support for TDM technologies will be required for the foreseeable future. Simply put, forcing an IP transition trial onto one of the 3,300 serving wire centers that provide the FAA with TDM services could dramatically harm safe air travel in the U.S.

Wireline-to-wireless trials are also a concern. The Commission indicated there is potential for service quality degradation with wireless replacements. FTI critical services have high availability requirements that may not be achievable with a wireless-only implementation. Performance issues encountered with these services moved to a wireless delivery could result in impacts to air traffic control operations.

Thus, as the Commission considers trials or any other action to force an IP and/or wireless transition, it must take steps to ensure that the trials are conducted in a manner that does not have

[2] See Harris Comments, AT&T Petition to Launch a Proceeding Concerning the TDM-to-IP Transition (filed Nov. 7, 2012) (AT&T Petition), GN Docket No. 12-353 (filed Jan. 25, 2013) (Harris Comments on AT&T Petition).

the potential to disrupt the operation of the FTI network or otherwise adversely impact air traffic safety. As a threshold matter, the Commission should limit the trials to non-mission critical services to prevent harm to critical communications currently dependent upon TDM wireline services. Lastly, any IP or wireless transition plan must assess the impact of such action of inevitable denial of service, eavesdropping/interception, and communication isolation upon critical communications.

II. THE COMMISION SHOULD NOT ALLOW IP TRANSITION TRIALS AT SERVING WIRE CENTERS THAT PROVIDE FTI TDM SERVICES.

As Harris has made clear, the FAA relies upon vital TDM services in order to maintain air traffic safety.[3] FTI procures several types of TDM services from telecommunications providers including: Analog Voice Grade, Digital Data Service (DDS), T-1s, T-3s, and ISDN PRIs.[4] Even on a limited trial basis, a cessation of these TDM services could dramatically impair the ability of the FTI program to provide our nation a network that supports safe and efficient air travel.

The FAA's NAS applications, which operate natively using synchronous protocols, require a highly reliable synchronization source with exceptional stability. Without the inherent synchronous capability of TDM, applications will experience out of sync clocks, leading to buffer overflows, lost frames and variable latency; such an outcome will have a detrimental impact on the operation of these critical NAS applications. The very nature of IP networks, with packet-based switching, dynamic routing and application retries, results in variable and non-

[3] *See* Harris Comments on AT&T Petition at 7-10.

[4] Specific interface and performance requirements crucial to FTI for each of these service types are provided in Appendix 1.

deterministic latency. Most FAA radio communications services utilize Phase Shift Keying (PSK) to maintain connectivity between the control site and the remote radio site. PSK is very sensitive to discarded packets. While PSK has proven extremely robust under legacy analog and digital transport, when transported over IP networks a single discard of a packet transporting 20 milliseconds of audio will result in the radio being unavailable to air traffic controllers for 2-4 seconds as the link is reestablished. Thus, without the deterministic performance and reliability offered with TDM services, the FAA's National Airspace System is at best degraded and at worst put at significant risk.

The Commission is considering regional trials for this technology migration. The NAS is a tightly integrated system with equipment in over 4,400 sites nationwide. To be included in this trial, the NAS would have to adapt to new telecommunications interfaces in the trial area and address interoperability issues with the legacy telecommunications interfaces throughout the remainder of the country. NAS systems cannot be selectively upgraded based upon the geographic availability of IP-based services; the air traffic control system must have commonality and be interoperable nationwide.

For these reasons, it is crucial that the Commission prevent trials from interrupting FAA systems designed to protect air travel safety. No trials should be conducted at serving wire centers that are used by FTI for TDM services unless there is a clear path to replacement of the essential TDM functionalities upon which FTI relies for air traffic control.

Ultimately, Harris urges that, if the Commission proceeds with IP transition trials, it should conduct them with non-mission critical customers only. FTI utilizes many special services for air traffic control operations. Testing with non-mission critical customers first will provide an

opportunity to evaluate the performance and interoperability of these new technologies while reducing the potential impact to public safety.

III. SERVICE DEGRADATION INHERENT IN WIRELINE TO WIRELESS TRANSITIONS WOULD HARM FAA OPERATIONS.

A. A Wireless-Only Solution is Not Viable for FAA Operations.

Recognizing the threat of service quality degradation in a wireline to wireless transition, the Commission seeks input on the challenges inherent in a wireless-only for consumers.[5] For the FAA, a wireless-only trial presents serious challenges; FTI offers a range of services, the most critical have a stringent availability requirement of 0.9999971 in a rolling 12-month period. Moreover, critical services such as those provisioned by FTI are typically implemented with two diverse paths and automatic protection switching to achieve the higher availability requirements. For most critical FAA sites, the two diverse paths are wireline. For the balance of critical sites, one path is a wireline service and the second path is implemented with private point-to-point microwave or satellite communications. The FTI availability requirements may not be achieved by wireless-only options. Many FAA services, including air/ground radio, navigation and weather equipment feeding the FAA and the National Weather Service use analog modems. Results from recent wireless access tests have shown a lack of compatibility of wireless replacement services with modem audio (such as credit card terminals) and, in some cases, even Dual-Tone Multi-Frequency (DTMF) tones. Again, a wireless-only option should not be conceived for services relied upon by FTI.

[5] Task Force Trial PN at 8.

B. Wireless-Only Trials for Non-critical Services Must Include Collection of Network Reliability Data.

The Commission seeks comment on whether to require network reliability data collection in a wireless-only trial.[6] Should the Commission press ahead with a wireless-only trial for non-mission critical services, the collection of network reliability measures is critical to any evaluation of the technology being assessed. The reliability measurements and the method of measurement should be published as an output of these trials. Additionally, service availability should be a key measurement in such trials to ensure wireless solutions meet or exceed availability of existing wireline offerings. Tests should be conducted with a range of atmospheric conditions typical for the trial area. Congestion should also be considered to measure the maximum number of customers supported by the wireless implementation. During emergency situations such as the earthquake that occurred in Washington DC two years ago, or more recently, Hurricane Sandy, continued operation of FAA systems are even more critical. The trials should demonstrate how bandwidth will be reserved and how latency and error free performance will be guaranteed for safety critical users such as the FAA.

IV. IP AND WIRELESS TRANSITION TRIALS MUST ASSESS INCREASED HARM FROM DENIAL OF SERVICE, EAVESDROPPING/INTERCEPTION, AND COMMUNICATION ISOLATION.

When considering forced IP and wireless transition trials, it is vital to recognize that these technologies introduce additional security concerns over and above those seen with traditional TDM and wireline technologies, and thus require specific testing to ensure secure communications. In particular, Denial of Service vulnerabilities are more prevalent with wireless

[6] *See* id. at 9.

and IP technologies providing additional opportunities for adversaries. These technologies allow adversaries to introduce different tactics than those used to attack TDM services resulting in the need for extensive testing. Tactics such as the introduction of rogue wireless access points and frequency jamming strategies are common and should therefore be tested to verify that this type of attack would be detected and/or prevented in wireless environments. Eavesdropping on communication is much less difficult in both IP and wireless environments than in traditional wireline technologies. This may be due to rogue rerouting or copying of packets in an Ethernet solution or sniffing a wireless transmission in an open physical environment utilizing commonly available tools. Solutions and monitoring must be deployed and tested to ensure detection and/or prevention of this type of activity. Finally, due to the nature of IP and wireless technologies not being traditional TDM wireline communications, testing is required to ensure that one customer's communication is isolated from other customer's communications using the same physical infrastructure and logical connections. In conclusion there are three primary security requirements which should be tested with during the trials: denial of service, eavesdropping/interception, and communication isolation.

V. CONCLUSION

The FAA currently has a 92% reliance rate upon wireline TDM services provided by commercial telecommunications providers. These services and applications utilizing the TDM-based technology form the backbone of the telecommunications structure for the NAS. Without use of such services in trial areas, the FAA's ability to ensure the safety of air traffic control operations would be jeopardized. In the event that the Commission approves a plan to experiment with the cessation of TDM in targeted wire centers, it must avoid including the more than 3,300 SWCs

that currently provide the FAA with TDM services. Without such protection, the FAA's operations will be put at risk.

For the foregoing reasons, Harris urges the Commission to consider the recommendations above as it assesses action pursuant to this proceeding.

Respectfully submitted,

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APPENDIX 1

SPECIAL SERVICE REQUIREMENTS

FTI is implemented with several TDM-based carrier-provided special services which will be significantly impacted if FTI is incorporated into the IP and/or wireless transition trials. Such services, whose interface and performance requirements are detailed below, include Analog Voice Grade, Digital Data Service (DDS), T-1s, T-3s, and ISDN PRIs. FTI service parameters are defined and supported by Telcordia (Bellcore) standards and contained in the Network Channel (NC) and Network Channel Interface (NCI) specifications documentation.

The FAA's National Airspace System (NAS) applications have evolved to be highly dependent on the synchronous nature of TDM telecommunications infrastructure. The inherent Constant Bit Rate (CBR) capability of TDM services enables NAS applications to establish clock synchronization as well as deterministic latency and jitter performance. Requirements for clock, latency and jitter are also defined below.

An outcome of the trial should identify which of the requirements listed in this appendix can be achieved with IP and/or wireless service delivery.

1. Interface and Performance Requirements

1.1 Analog Voice Grade Services

(a) Impedance - Each analog interface of the Analog Voice Grade circuit shall have an impedance of a nominal 600 ohms when measured at 1,004 Hertz (Hz).

(b) Termination - Each Analog Voice Grade circuit shall be connected to the customer demarcation point by four wires, including a transmit pair and a receive pair.

(c) Connectors – Standard commercial connectors shall be used for all interfaces.

(d) Maximum Signal Power at Demarcation –

(1) The customer demarcation point shall be a zero transmission level point (0 TLP) for transmitted and received signals for all analog interfaces.

(2) The circuit shall accept signals at the customer demarcation point that have a maximum power of -13 dBm as averaged over any three-second interval at the 0 TLP.

(f) Analog Voice Grade services shall conform to section 5.8 in Bellcore TR-NWT-00035.

(g) The Analog Voice Grade service shall meet the Immediate Action Limit (IAL) requirements for the EU-POT for Analog Voice Grade special access service as specified in Section 5.8 of Bellcore TR-NWT-000335 except as follows:

(1) Signal Gain – The service shall provide unity signal gain between A and Z

locations

(2) Gain Hits - The gain hits of the analog interface shall not exceed two hits in any 15-minute interval. A gain hit is defined as a gain variation greater than three decibels (dB), lasting longer than four milliseconds (ms), when measured in accordance with ANSI/IEEE STD 743-1984, using the faster counting rate of 100 counts per second.

(3) Phase Hits - The phase hits of the analog interface shall not exceed eight hits in any 15-minute interval. A phase hit is defined as a 20-degree or greater phase deviation, lasting longer than 4 ms, when measured in accordance with ANSI/IEEE STD 743-1984, using the faster counting rate of 100 counts per second.

1.2 Digital Data Service (DDS)

(a) The DDS interface shall be required to provide primarily for digital data transmissions between defined customer demarcation points.

(b) The DDS interface shall support data transfer rates of 56 and 64 kbps.

(c) The DDS interface shall meet the following interface requirements:

(1) DDS interface shall conform to the requirements of ANSI T1.410-1992 except as otherwise specified herein.

(2) DDS interface shall meet the formatting requirements of ANSI T1.410-1992.

(3) Synchronization between the DDS Service Type circuits and Government equipment shall be in accordance with the requirements of Bellcore GR-000436.

(4) DDS interface shall provide line coding in accordance with ANSI T1.410-1992.

(5) DDS interface shall support DS-0B formatting in accordance with Bellcore GR-499-CORE Section 10.1.2

(6) DDS interface shall support DS-0A formatting in accordance with Bellcore GR-499-CORE Section 10.1.2.

(7) DDS interface shall provide the secondary channel, in accordance with ANSI T1.410-1992.

(8) DDS interface shall support latching and non-latching loopbacks (remote and local)

(d) The DDS shall conform to the specifications in ANSI T1.410-1992.

(e) The DDS services shall provide a minimum of 99.9 percent error free seconds for any 24-hour period.

1.3 T-1Services

(a) The T-1 interface shall provide digital signal speeds of 1536 kbps in an unchannelized format per section 10.2.5.1 of Bellcore GR-499-CORE.

(b) The T-1 physical interface shall conform to the requirements of section 6 of ANSI T1.403-1999.

(c) T-1 services shall meet all requirements specified for an unchannelized application in section 10.2 of Bellcore document GR-499-Core.

(d) The T-1 service shall provide a minimum of 99.9 percent error free seconds for any 24-hour period.

1.4 T-3 Services

(a) The service shall also support an unchannelized application carrying a payload of 44.210 Mb/s.

(b) T-3 services shall meet requirements specified in Bellcore document GR-499-CORE. Additionally, T-3 services shall meet a Bit Error Rate (BER) of less than one times ten to the minus five (1 x 10-5).

(c) Two types of T-3 interfaces shall be required to provide primarily digital data transmissions between two access customer demarcation points or an access customer demarcation point and a network provider's point of presence (POP). The T-3 interfaces types are composed of Fractional T-3 (F3) and T-3 (DS-3).

(d) Connection to T-3 services shall utilize BNC connectors and 75 ohm coax cable meeting the criteria specified in Section 9 of ANSI T1.404-2002.

1.5 ISDN PRI Services

(a) The ISDN PRI interface shall support the 23B+D (1.544 Mbps) configuration at reference points U, S and T.

(b) The interface shall conform to the requirements specified in the following standards.

(1) ANSI T1.403.01-1999, Telecommunications – Network and Customer Installation Interfaces – Integrated Services Digital Network (ISDN) Primary Rate Layer 1 Electrical Interface Specification.

(2) ANSI T1.408 Integrated Services Digital Network (ISDN) Primary Rate - Customer Installation Metallic Interfaces (Layer 1 Specification).

(3) ITU I.431, Integrated Services Digital Network (ISDN) – ISDN User-Network Interfaces (03/93), section 4, Interface at 1544 kbit/s.

(c) The ISDN connectivities shall provide service in accordance with ITU-T standards Q.930, Q.931, Q.920, Q.921, and I.431.

(d) The ISDN Primary Rate Access (PRA) shall meet the performance objectives and requirements specified in ITU-T standards I.352, I.354, I.355, and I.359.

2. Interface Synchronization Requirements

2.1 Clock Sources

The clocking of the interfaces shall be implemented with an Internal-Locked, Loopback-Locked, Internal –Independent or External-Independent clock source. The Internal-Locked clock source shall be the default configuration.

(a) The Internal-Locked (IL) clock source shall be implemented by having the signals at the Transmit Signal Element Timing (DCE Source) (ITU 114) and the Receiver Signal Element Timing (DCE Source) (ITU 115)leads at the customer DTE be provided by the service provider's clocking source traceable to the Stratum 1 clock. Transmitted Data (ITU 103) will be clocked by Transmit Signal Timing Element (DCE Source) (ITU 114). Received Data (ITU 104) will be clocked by Receiver Signal Timing Element (DCE Source) (ITU 115).

(b) The Loopback-Locked (LL) clock source shall be implemented by having the signals at the Transmit Signal Element Timing (DCE Source) (ITU 114) and Receiver Signal Element Timing (DCE Source) (ITU 115) leads at the customer DTE be provided by the service provider's clocking source traceable to the Stratum 1 clock. The government DTE will loop the clocking on the Transmit Signal Element Timing (DCE Source) (ITU 114) of the DTE back to the Transmit Signal Timing Element (DTE Source) (ITU 113) to create "loop timing." Transmitted Data (lead BA--ITU 103) will be clocked by Transmit Signal Timing Element (DTE Source) (lead DA--ITU 113). Received Data (ITU 104) will be clocked by Receiver Signal Timing Element (DCE Source) (ITU 115).

(c) The Internal-Independent (II) shall be implemented by having the signals at the Transmit Signal Element Timing (DCE Source) (ITU 114) lead at the customer DTE be derivable from a customer clock source, or be provided by the service provider's clocking source traceable to the Stratum 1 clock. The Receiver Signal Element Timing (DCE Source) (ITU 115) lead at the service provider DCE will be provided by the customer's far-end DTE clock source and transported through the network. Transmitted Data (ITU 103) will be clocked by Transmit Signal Timing Element (DTE Source) (ITU 114). Received Data (ITU 104) will be clocked by Receiver Signal Timing Element (DCE Source) (ITU 115).

(d) The External-Independent (EI) source shall be implemented by having the signal at the Transmit Signal Element Timing (DTE Source) (ITU 113) lead at the service provider DCE be provided by the customer clock source. The Receiver Signal Element Timing (DCE Source) (ITU 115) lead at the customer DTE be derivable from a customer clock source, or be provided by the service provider's clocking source traceable to the Stratum 1 clock. Transmitted Data (ITU 103) will be clocked by Transmit Signal Timing Element (DTE Source) (ITU 113). Received Data (ITU 104) will be clocked by Receiver Signal Timing Element (DCE Source) (ITU 115).

2.2 Independent or Locked Modes

The clock sources shall operate in either a locked mode or an independent mode. The service provider shall configure the clocking of the circuit for either independent or locked mode of operation as described in 2.1 above.

(a) Independent (I) mode requires that the service provider's DCE generates a receive clock from the speed-corrected receive data stream. Either the receive clock or the transmit clock, but not both may be traceable to the Stratum 1 clock source.

(b) Locked (L) mode requires that both the service providers Receiver Signal Element Timing (DCE Source) (ITU 115) and Transmit Signal Element Timing (DCE Source) (ITU 114) clocks at the DCE provided by the service provider's clocking source be traceable (locked) to the Stratum 1 clock.

3. Latency Requirement

Many FTI services have a 50 millisecond latency requirement from customer demarcation point at one site to another both inter and intra LATA.

4. Jitter Requirement

The intrinsic jitter at 1544 kbit/s output interfaces as measured over a 60-second interval shall not exceed 0.015 UIpp Unit Intervals) when measured through a single pole band-pass filter with corner frequencies at 10 Hz and 40 kHz.